

A Software Framework for Coordinating Human-Robot Teams, Phase I

Completed Technology Project (2007 - 2007)



Project Introduction

Robots are expected to fulfill an important role in manned exploration operations. They can reduce the risk of crew EVA and improve crew productivity on routine tasks. They can be supervised locally by astronauts or remotely by ground control. In a sense, robots will become members of the operational team. Just like human teams, these human-robot teams must exchange information, follow established protocols, and coordinate their activities to ensure that mission operations are safe and effective. Supporting such team operations requires infrastructure for human-robot interaction. TRAC Labs proposes to develop a software framework that facilitates human-robot teaming, from team formation until completion of team operations. We will build on the existing Distributed Collaboration and Interaction (DCI) System, a software multi-agent system developed by TRAC Labs to assist human-automation interaction. DCI provides a software agent for each human team member that delivers services supporting mission duties. An innovation of this project is providing DCI agents for robots as well as humans in the team. Another innovation is the use of human models to give robots insight into human behavior to improve interaction. Phase I will produce a software framework prototype for human-robot interaction and a framework design for implementation in Phase II.

Anticipated Benefits

Potential NASA Commercial Applications: Unmanned air and ground vehicles are becoming more common in battlefield situations. Future Combat Systems envision manned and unmanned vehicles of all sizes working side-by-side. Additionally, Congress has mandated that one-third of all military vehicles must be unmanned by 2015. The military envisions robots and soldiers working side-by-side to accomplish missions, as well as remote operators supervising robot teams. Currently several operators control one autonomous vehicle. The proposed framework for human-robot interaction will help reverse this ratio. Non-military markets include civilian SWAT teams, urban search and rescue and hostage situations. There are approximately 100 US cities with populations over 200,000 that could have use of a mobile robot for search and rescue, bomb disposal or hazardous materials handling. Often a single mobile robot will perform many different tasks. Operators will typically have less training and experience in using robots than military operators, thus support for effective human-robot interaction is essential.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

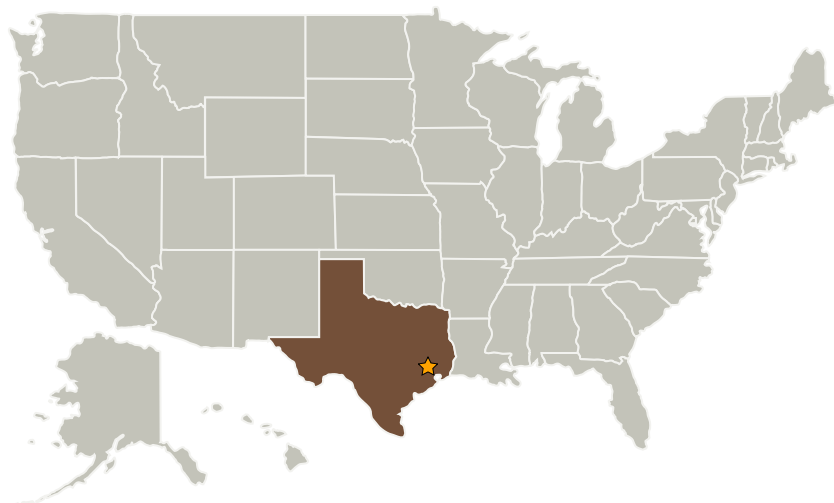
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
TRAC Labs, Inc.	Supporting Organization	Industry	Webster, Texas

Primary U.S. Work Locations

Texas

Project Transitions

**January 2007:** Project Start**July 2007:** Closed out**Closeout Summary:** A Software Framework for Coordinating Human-Robot Teams, Phase I Project Image

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX04 Robotic Systems
 - └ TX04.4 Human-Robot Interaction
 - └ TX04.4.2 Distributed Collaboration and Coordination